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M.R.P. 1029
S.C.I./123
21st January, 1957

AIR MINISTRY

METEOROLOGICAL RESEARCH COMMITTEE

Draft Report of the Chairman of the Instruments Sub-Committee to the Meteorological Research Committee for the year ending 31st March, 1957

1. Constitution The Sub-Committee was constituted by the Meteorological Research Committee in March, 1948. The membership at the end of the year under review was:-

Dr. A. W. Brewer (Chairman)	-	Oxford University
Instructor Commander K. A. Bowell	-	Naval Weather Service
Mr. N. E. G. Hill	-	Ministry of Supply, R.A.E.
Dr. H. G. Hopkins	-	Radio Research Organisation (D.S.I.R.)
Dr. A. J. Maddock	-	British Scientific Instruments Research Association
Mr. S. W. Noble	-	Ministry of Supply, R.R.E.
Dr. B. J. Mason	-	Imperial College, London
Mr. B. C. V. Oddie	-	A.D.M.O. (P.R.)
Dr. F. J. Scrase	-	A.D.M.O. (I.D.)
Dr. J. M. Stagg	-	P/D.D.M.O.
Dr. R. C. Sutcliffe	-	D.D.M.O. (R.)

2. Meetings and Papers. The Sub-Committee held three meetings at which 13 papers and reports were considered (See Appendix).

3. Present position regarding the more important items. The following notes refer to some of the more important items of the Programme of Investigations 1956/57 (M.R.P. 967A).

(a) Aircraft thermometer elements and indicators (I.1(a)(i))

The flight tests of the experimental model conical-head thermometer referred to in last year's report have not yet been made, owing to delays in preparation of the aircraft (at Bedford). Two other models, one having a thimble of dural instead of pure aluminium, were made and flown (at M.R.F. and Boscombe Down). The recovery factors were found to be in good agreement with the theoretical value. The dural thimble is much less fragile than the aluminium, and equally satisfactory in performance.

Several types of thermometer including two types of vortex thermometer have been mounted on the Hastings aircraft of M.R.F. in preparation for an intensive trial of their performance in cloud.

The self-balancing Wheatstone bridge continues to give trouble owing to build-up of contact resistance in the relays after a period of idleness. It has not been possible to obtain suitable relays for the improved model. A mechanically balancing unit, developed as an alternative, is nearing completion.

(b) Frost-point hygrometers (I.1(b)(ii) and (iii))

The prototype of the visual pressurized instrument has been received from the manufacturers and passed as satisfactory for production.

The automatic hygrometer is awaiting flying trials, and a smaller

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Dr. B. J. Mason	-	Imperial College, London
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The automatic hygrometer is awaiting flying trials, and a smaller

version is nearly complete. Tests of the thimbles with rectangular and spiral film resistance elements have shown that the latter have considerable advantages but are more fragile and very difficult to manufacture in platinum. Rhodium is being tried as an alternative.

(c) Recorders for aircraft instruments (I.1(c))

A suitable camera has been obtained. A timing device to operate it is nearing completion, and the design of a panel and housing is in hand.

(d) The exposure of anemometers: field and wind tunnel investigations (I.3(c))

A memorandum on the measurement of surface wind (M.R.P. 989) was discussed by the Sub-Committee. The question of field investigations on this problem and on the determination of surface airflow in relation to problems in farming and forestry is to be considered by the Physical Sub-Committee.

(e) Rainfall at sea (I.4(b))

There is, unhappily, still no real progress to report. No combination of site and instrument has yet been discovered which yield measurements of rainfall which can be shown to be, or can reasonably be assumed to be, accurate to within ±20 per cent in monthly totals.

(f) Slant visibility (I.5(b) and (c))

Apparatus is being constructed for the routine measurement of the variation of slant visibility with height, using a string of lights carried by a captive kite balloon; the lights (or black objects by day) being observed through a Gold visibility meter (or through a disappearance Range Gauge by day).

(g) Modulated cloud searchlight (I.6(a)(ii))

The instrument was resited at London Airport with a shorter (350 ft.) base line, early in December, 1956, and is now working satisfactorily. Useable continuous records, by day and night, are being obtained whenever the cloud base is below 2,000 ft. ~~The trace~~ is rather broad and methods of reducing this are being considered.

(h) Improvement of Mk.IIB sonde (I.7(a)(i))

An improved method of testing and selecting the mumetal laminations for the inductances was adopted on a routine basis. It was found that the permeability of the mumetal can be seriously impaired during assembly of the inductances, and that pressure units containing these inductances have large temperature coefficients. This source of trouble has been eliminated, with a consequent reduction in the corrections required

Analysis of errors, particularly random errors, has continued, though slowly, using observations obtained during routine soundings with the Mk.IIB radio sonde.

(i) Radar sonde system (I.7(a)(ii) and (b)(ii))

Great difficulty was experienced in the trials, and the shortcomings of the equipment were found to be even more serious than was realised at first. The situation was reviewed by a working party composed of representatives of the Meteorological Office and the Contractor and the report submitted to D.M.O. contains an assessment of the present position and recommendations for future policy.

Some progress was made in the development of a resistive unit for pressure and humidity. The attempt to produce a metal film resistor has

been abandoned and a wire-wound resistor adopted instead.

(j) Radar wind equipment (I.7(b)(i) and (iv))

The following titles have been adopted for radar sets modified by the Meteorological Office for upper wind measurement:

GL3 : M.O. Wind-finding radar Type 1
277P: " " " " " 2
GL7 : " " " " " 3

Type 1. Manufacture of the head amplifier Mk.II was completed and the units are awaiting installation. Manufacture of the error-sensing unit Mk.I is nearly complete. Experiments were made on the effect of cooling the crystal detector and mixer unit; a marked improvement in range was obtained. All sets at upper-air stations have been converted to read range in metres instead of yards. The design is well advanced of a new delay unit, which will provide a range scale trebler of improved stability suitable for both the Type 1 and the Type 2 sets, with the possibility of a further extension of the range scale, which may be justified by current improvements in radar sets and targets.

Type 2. Wind-finding by radar on Ocean Weather Ships has continued to be studied by a working group consisting of representatives of the Meteorological Office and No. 90 Group, R.A.F. A type 277P radar has been acquired by No. 90 Group for tests of short term modifications. On the long term policy for the development of a ship-borne radar specifically for wind finding, the drafting of a specification has been held in abeyance until the land station policy can be decided in the light of the radar sonde trials.

Type 3. The Meteorological Office experimental set was overhauled and modernized by a commercial firm under Ministry of Supply contract. Improvements were made in the prototype range scale trebler, of which drawings are being made with a view to manufacture.

(k) Improvement of R.D.F. technique for locating thunderstorms (I.8(a))

Improved accuracy in locating thunderstorms has resulted from the installation of Mk.III (Cintel) C.R.D.F. equipment at the "sferic" stations in the United Kingdom.

Successful results were obtained in trials with "sferic" apparatus installed at Gibraltar and Oslo; in particular, the Gibraltar bearings greatly improved the accuracy of thunderstorm location over eastern and southeastern Europe and over the Atlantic.

For the counting of lightning flashes a recording counter has been developed and operated from the C.R.D.F. set at Dunstable at a setting corresponding to a measure of the level of thunderstorm activity over approximately 200 miles. In addition, lightning flash counters developed by the Radio Research Organisation for a range of 20 to 40 miles and indicating by visual counting scales, have been installed at Dunstable, London Airport and Victory House, Kingsway.

(l) Exposure errors at sea (I.9(a))

Comparisons, using Assmann psychrometers, on Ocean Weather Ships seem to show that there may be exposure errors (i.e., errors due entirely to exposure and not to the use of a screen instead of an Assmann) amounting to 1 or 2 degrees (F) in temperature and 5 degrees in dew point.

/(m)

(m) Development of instruments for measuring water contents in cloud and rain (I.12(a))

Several instruments based on hot wires, wetted paper, refrigerated discs, and a lithium chloride type have been tested. All of these are capable of giving indications of water content each in rather limited conditions. The main difficulty, however, in each case is the establishment of a valid calibration and this is at present under consideration.

A recent development is a reversion to the method using the direct catch of water by forward facing scoops. Some success has been achieved in M.E. Department R.A.E. and on the M.R.F. Hastings aircraft and the Bristol Britannia aircraft but the basic calibration position is still unsatisfactory.

(n) Development of instruments for measuring size distribution of water particles in clouds and in rain (I.12(b))

The principal contribution this year has been the introduction of the aluminium foil instrument in which impact of drops produces indentations in a continuously moving strip of foil. This device in different instruments is now in routine use by M.E. Department R.A.E., M.R.F. and Bristol Aero Engines Ltd., in different investigations. Records are obtained from water drops of about 100μ diameter upwards. Crystals also produce marks but further work is still required on their interpretation.

(o) Development of airborne nucleus and particle samplers (I.12(c))

A study is being carried out, in Physics Section, C.D.E.E., Porton, of the collection efficiency of the drum impactor used for airborne sampling of particles of zinc cadmium sulphide in the diffusion experiments of Item III.3(f)(ii). The tests are carried out in a cloud of particles in a chamber, with a special version of the impactor head mounted on a whirling arm. The numbers of particles collected at a relative air speed of 150 knots (the usual aircraft speed) do not differ greatly from those obtained with standard stationary sampling apparatus. For completeness the tests are also being carried out at the lower relative airspeed corresponding to use of the instrument from a motor vehicle.

(p) Instrumentation for microclimatology (I.13(a))

At Cambridge a technique has been developed for making thermocouples from wire of 0.002 inches or less in diameter. These are for use in the study of the vertical gradients of temperature and humidity over small intervals of height.

(q) Development of a recorder for surface aerodynamic drag (I.13(b))

The method of floating a detached sample of the surface has been abandoned in favour of a double pendulum arrangement which has the advantage that the condenser plates used in measuring the movement of the sample are exposed below ground level and away from temperature changes. The latter appear to cause zero drift. Some zero drift is still present in the new apparatus but it is thought to be due to imperfections in the home made knife edges etc. It is intended to produce drawings so that a model can be made commercially.

(r) Mobile meteorological unit (I.14(b))

The manufacture of a prototype to a design modified in the light of field trials is being arranged by the Fighting Vehicles Research and Development Establishment.

(s) High altitude searchlight (I.14(c))

Army searchlights have been received and one, which is to produce the modulated beam, is being modified. It is estimated that the equipment will be ready for preliminary field trials in 9 months time.

Appendix to M.R.P. 1029 (Report of Chairman of S.C.I)
List of papers and reports considered by the Instruments Sub-Committee in the year ending 31st March, 1957

M.R.P. No.	Title	Author
974	A vertical gustiness recorder for use with a captive balloon (Porton Technical Paper No. 536).	J. I. P. Jones
977	An electrical dewpoint hygrometer suitable for routine meteorological use.	J. MacDowall
983	The measurement of humidity at Britannia SØ 1952-53.	R. A. Hamilton
988	On the development of an improved daylight illumination recorder.	M. J. Blackwell and D. B. B. Powell
989	The measurement of surface wind.	R. Frith
997	A simple method for measuring atmospheric attenuation of light ("meteorological optical range" or visibility) at night.	K. H. Stewart
1010	Wind recording apparatus for the new Ballistic Range at Shoeburyness.	G. E. W. Hartley
1011	Nineteenth S.C.I Progress Report (March to August, 1956).	-
1021	Radio refraction in the free atmosphere.	A. H. Hooper and A. P. Taylor
1026	Proposed amendments for 1957/58 to Part I of the Research Programme for 1956/57 (M.R.P. 967A).	-
1029	Draft report of Chairman of S.C.I to the M.R.C., year ending 31st March, 1957.	-
1032	Response characteristics of the sensitive cup anemometer Type IV.	A. G. A. Rae
1033	Photo-electric visibility meter Mk.II.	J. R. Bibby

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